Final Report

Juvenile Fall Chinook Salmon Coded Wire Tagging Feasibility Study in The Deschutes River, Oregon

Cooperative Agreements:

COOP-02-075 and COOP-02-076*

Between Alaska Department of Fish and Game And The Columbia Inter-Tribal Fish Commission

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***SSSF Projects 45057 and 45058 respectively**

Introduction:

Upriver bright fall chinook are a major contributor to southeast Alaska (SEAK) and Canadian fisheries, and are of primary concern for the Pacific Salmon Commission (PSC). Deschutes River fall chinook salmon are one of the three naturally spawning stocks within the Columbia River fall chinook stock group under the new annex of the Pacific Salmon Treaty. Deschutes River fall chinook salmon have also been identified as an escapement indicator stock by the Chinook Technical Committee (CTC). Exploitation rates on these fish are needed to assist the PSC in monitoring effects of the abundance-based management approach of the Pacific Salmon Treaty on this stock, and to build an accurate data base of production for use when evaluating optimum spawning escapement levels.

There is a lack of data on ocean distribution and exploitation rates (both ocean and in-river) of Deschutes River fall chinook salmon. Currently, tagged sub-yearling releases from Lyons Ferry Hatchery are used, when available, as a surrogate for ocean distribution and exploitation of this stock. However, coded wire tag (CWT) data from a study conducted by the Oregon Department of Fish and Wildlife (ODFW) during the late 1970s indicated that Deschutes fall chinook salmon may have a more southerly ocean distribution than the Lyons Ferry Hatchery group. A successful Deschutes River CWT program would provide data on ocean distribution and exploitation, as well as, a direct estimate of in-river exploitation rates. A three year project would verify whether LFH tag groups can accurately represent Deschutes River fall chinook ocean distribution and exploitation when Deschutes River fall chinook tag data is unavailable.

During 1978-1980 ODFW marked and CWT a total of 123,000 juveniles from the 1977-79 broods during a fall chinook life-history study. All of the fish were captured by beach seining. An average of 40,000 fish were marked per year. Tag retention ranged from 97%-99%. Average handling mortality ranged from 1.1%-4.2%. The estimated CWT tag recovery rate was 0.8% (Jonasson and Lindsey 1988). Estimated run sizes during the period of this study were similar to present day estimates.

The results of this earlier project demonstrated that implementing a fall chinook CWT program in the Deschutes River is feasible. However spawning and post-emergence rearing distribution has likely changed. During the ODFW study the majority of juvenile fall chinook were captured above Sherar's falls. Due to a change in spawning distribution to below Sherar's falls new tagging locations need to be identified. The goal of this study was to locate concentrations of juvenile fall chinook that were vulnerable to seining, both above and below Sherar's falls, and to determine the appropriate time period to conduct a CWT project. This report summarizes the work completed during the spring, 2002, to determine the feasibility of implementing a CWT project for juvenile fall chinook salmon in the Deschutes River, Oregon.

Project Objectives:

Cooperative Agreement COOP-02-076:

1. Identify suitable juvenile fall chinook salmon capture locations in the Deschutes River.
2. Sample juvenile fall chinook salmon lengths during the months of April through July 2002.
3. Develop handling procedures and estimate handling mortalities.
4. Determine juvenile summer steelhead by-catch during seining.

Cooperative Agreement COOP-02-075:

1. Develop and implement protocols to measure tag retention on CWTed Deschutes fall chinook smolts.
2. Develop strategies to temporarily hold recuperating CWTed juvenile fall chinook salmon.
3. Estimate 24-hour mortality for CWTed juvenile fall chinook.
4. Release two experimental tag groups to allow future comparison of survival rates for fish released immediately versus fish held 24 hours and to allow determination of current tag recovery rates in ocean fisheries.

Cooperative Agreement COOP-02-076

Methods:

Sampling to determine suitable juvenile fall chinook salmon capture locations in the Deschutes River began 9 April and continued weekly through 7 July, 2002. From 9 April through 4 June one day each week was spent sampling above Sherar's falls (Rm. 77-100) and below Sherar's falls (Rm. 16-39).

Beach and stick seines were used to sample various instream habitats. From 9 April through 7 May an 80' long by 10' deep (5/16" mesh) beach seine was used to capture juveniles. The seine was secured on the streambank by a crew member while another crew member, wearing a drysuit, pulled the net out from the bank and swam it downstream and back to the shore. A crew member walked the shore end of the net downstream towards the swimmer. An additional crew member pulled both lead lines together until the net was bagged. The net was then pulled to shore until the cod end was visible. Captured fish remained in the river until they were removed from the seine with a standard aquarium net. The fish were placed in a five gallon bucket prior to enumeration.

From 8 May to 7 July two stick seines were used to capture fish. The seines were 30' and 18' long by 4' deep (3/16" mesh). The seines were operated by two crew members who walked the net downstream through the habitat unit. The net was pursed at the downstream end of the tow and the fish were collected using the methods described above.

Habitat types sampled included pools, glides and riffles with varying bottom substrates including mud, sand, gravel, cobble and some boulders. Riparian vegetation adjacent to each sampling location included grasses, sedges, cattails and alders. Both instream and riparian habitat at each sampling location was recorded.

From 9 April to 4 June one or two seine sets were made at each sampling site. Seining effort averaged 3 hours per day. Captured fish were enumerated and identified to species. Up to 30 fall chinook salmon were measured for length (FK) at each site. A total of 100 fish were measured each sampling day. All juvenile spring chinook salmon were retained for length measurement.

From June through mid-July sampling occurred 4-5 days per week. From 5 June through 27 June all sampling occurred downstream of Sherar's falls. From 2 July through 11 July sampling was conducted upstream of Sherar's falls. All captured fall chinook salmon were retained for coded wire tagging (refer to Objectives 1-4 in Cooperative Agreement Coop-02-075). One-hundred fish each week were randomly selected for length and weight measurement during this period.

Results:

Juvenile fall chinook salmon were present above and below Sherar's falls throughout the sampling period. The fish were most abundant in glides and slow water areas adjacent to grassy river banks from April through May. The highest concentrations of fish were found adjacent to spawning beds. Unlike juvenile fall chinook salmon, juvenile spring chinook salmon were captured mainly at the heads of riffles and to a lesser degree in pool tailouts. From early June through the end of the sampling period in mid-July juvenile fall chinook salmon moved away from the streambanks and were most abundant in riffles and seem lines between eddies and the main current. Juvenile spring salmon were not encountered during this period and were presumed to have out-migrated.

Below Sherar's falls the majority of fish were captured near the major spawning beds from April through May but moved downstream during June. Above Sherar's falls most of the fish were captured near the major spawning areas between Rm. 95-98 throughout the entire study period (Table 1).

Table 1. General capture locations of juvenile fall chinook salmon from April through early July, 2002.

	Date	River Mile	Location
Below Sherar's falls	4 April - 15 May	24 - 39	Mack's Canyon to Pinetree Boat Ramp
	16 May – 27 June	10.5 - 25	Green Light Rapid to Ferry Canyon
Above Sherar's falls	4 April – 11 July	80 - 98	Kaskella Rapid to Warm Springs Boat Ramp

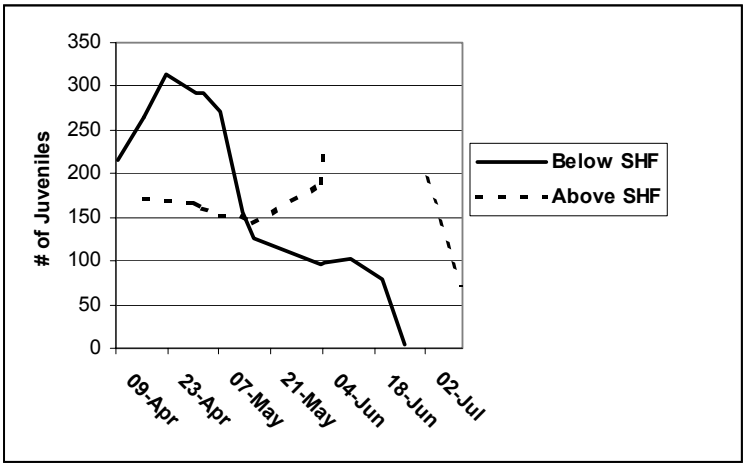

Figure 1. Catch per hour of seining effort for juvenile fall chinook salmon.

Catch rate, measured by hours of seining effort, below Sherar's falls was greatest from 9 April to 7 May. The catch rate declined dramatically thereafter. Catches were more consistent above Sherar's falls from April through early June. Due to the lack of sampling above the falls during June it is unclear when the peak catch would have occurred. However, the catch rate declined significantly by 11-July (Figure 1).

The average fork length of juvenile fall chinook salmon during mid-April was 46.5 mm. We used the date after which the mean fork length of fry continuously exceeded 45 mm to indicate the completion of emergence (Cramer and Martin 1978). Emergence was complete when sampling began. By the time sampling ceased the average length had increased to 78 mm (Tables 3 and 4).

Table 3. Juvenile fall chinook salmon average and range in fork length below Sherar's falls from 9 April through 26 June 2002.

Date	Ave. Fk. Length (mm)	95 % CI	Range (mm)
4-9	45	1.19	35-69
4-22	51	1.3	36-73
5-7	52	1.57	36-85
5-13	58	1.89	39-94
6-3	61	2.06	40-99
6-6	79	1.5	62-98
6-11	79	1.5	62-98
6-20	80	2.22	55-100
6-26	80	2.04	58-120

Table 4. Juvenile fall chinook salmon average and range in fork length above Sherar's falls from 16 April through 11 July 2002.

Date	Ave. Fk. Length (mm)	95 % CI	Range (mm)
4-16	48	1.15	35-69
4-30	46	1.16	33-62
5-2	61	2.29	40-90
5-16	58	2.22	37-95
5-20	58	2.13	37-86
6-4	69	2.55	45-101
7-2	67	2.0	55-96
7-11	76	2.4	56-112

Other fish species captured during seining, in order of abundance, included speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), chiselmouth (*Acrocheilus alutaceus*), large scale and bridgelip suckers (*Catostomus macrocheilius & columbianus*), mountain whitefish (*Prosopium williamsoni*). The following species were captured in very low numbers: sockey salmon juveniles (*Oncorhynchus nerka*), spring chinook salmon juveniles (O. tshawystcha), coho salmon juveniles *(O. kisutch*), rainbow trout/steelhead juveniles (*O. mykiss*) and pacific lamprey ammocoetes (*Lampetra tridentata*).

Rainbow / steelhead fry were captured in very low numbers (<20 total) during early July. Spring chinook salmon smolts were captured only during late April. They were easily distinguished from fall chinook salmon juveniles by their large size (>80 mm FK) and habitat preference i.e. spring chinook were captured in riffles when fall chinook were largely absent from this habitat during April.

Discussion:

Beach and stick seines are viable techniques for capturing juvenile fall chinook salmon in sufficient numbers for coded wire tagging. Stick seines are effective when fall chinook salmon inhabit shallow glide habitat along the streambanks during April and May. Beach seines are most effective during June and July when the fish move away from the streambanks to occupy feeding stations in deeper water along the seem lines of eddies.

The lengths of juvenile fall chinook salmon at the time of peak out-migration (as determined by rapidly declining catch per hour of seining) differed from Jonasson and Lindsay's (ODFW 1988) work in the late 1970's but the timing of peak out migration was similar (Table 5).

Table 5. Comparison of timing of out migration and length of juvenile fall chinook salmon in the Deschutes River in 1979 and 2002.

Study Section	Study Year	Time of Migration	Mean FK Length (mm)
Below Sherar's Falls	1979	13 May – 09 June	55
	2002	"	80
Above Sherar's Falls	1979	29 June – 12 July	92.2
	2002	"	76

Juvenile fall chinook salmon were captured at similar rates above and below Sherar's falls during April and May. By early June however catch rates below Sherar's falls fell dramatically. Catch rates above Sherar's falls remained constant until early July. This indicates that juvenile out-migration is complete by early June below Sherar's falls and by mid- July above the falls.

The difference in juvenile fall chinook out migration timing above and below Sherar's falls may be explained by the rapid increase in water temperature in early June below the falls compared to that above the falls (figure 2).

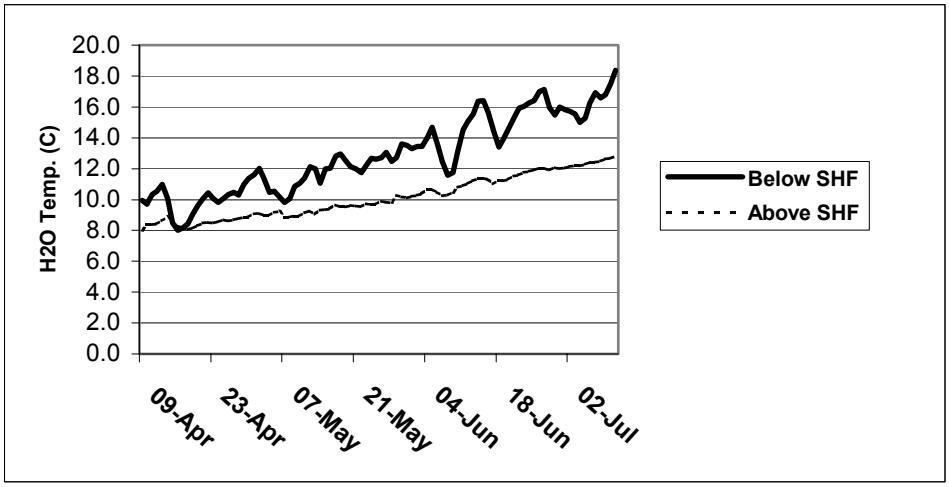

Figure 2. Daily average water temperatures recorded above and below Sherar's falls during April –July, 2002.

The rise in water temperature to 14^{o}C may have triggered juvenile fall chinook salmon out migration in during June below Sherar's falls. Cooler water temperatures above Sherar's falls may delay out migration until July (Table 6).

Table 6. Seven day average water temperatures (C) above and below Sherar's falls during April-July 2002.

	Below Sherar's falls	Above Sherar's falls
April	9.9	8.4
May	11.9	9.4
June	14.8	11.2
July	17	12.8

The by-catch of resident rainbow/steelhead was very low during the sampling period. These fish were captured incidentally only during July. If the tagging program is completed by July the chances of handling this ESA protected stock should be minimal.

Cooperative Agreement COOP-02-075

Methods:

Due to delays in equipment delivery coded wire tagging did not start until 4 June. Tagging began below Sherar's falls and continued until 27 June when catch rates declined significantly. Tagging above Sherar's falls took place between 2 July - 11 July.

Juvenile fall chinook salmon were captured for tagging using stick and beach seines at various locations and habitats described above. A crew of 3-4 captured the fish. Captured fish were removed from the seines with aquarium nets and placed in 5 gallon buckets. After each set the fish were transferred to a jet sled equipped with two 20 gallon aerated holding tanks. Fresh river water was frequently added to the tanks to moderate water temperatures. When approximately 500 fish were in each tank they were transported to a 4'X 4' (3/16" mesh) holding pen anchored in a calm water eddy at the tagging location.

The fish were held overnight and tagged the following morning. Groups of 500 fish were transferred from the holding pen and placed in 20 gallon holding tanks at the tagging station. Up to 100 fish at a time were placed in a tub and sedated with a light dose of MS-222 (5 g per liter) for size sorting. The fish were sorted into two length groups (55-69 mm fk and >70 mm fk) and placed in separate 20 gallon holding tanks. Fish less than 55 mm were released after they had recovered from anesthesia. Fish that were missing an adipose fin (i.e. re-captures) were checked for tag retention prior to being released.

A single Mark IV tagging machine was used to tag the fish. Fish between the length of 55-69 mm were tagged using a 90 fish per lb head mold. A 65 fish per lb head mold was used to tag fish 70 mm and longer. Standard length decimal tags were used. Unique tag codes were used for fish tagged above and below the falls and by release strategy (described below). Prior to tagging, groups of 50 fish were anesthetized in a solution of 19 g per liter of MS-222. Before each fish was tagged the adipose fin was removed. A crew of 3-4 sorted, removed the adipose fin and tagged the fish.

On Tuesdays through Wednesdays the tagged fish were placed in a holding pen and held for 24 hr prior to release. Each morning 100 fish, tagged the previous day, were randomly selected and checked for tag retention using a V-shaped portable sampling detector. If more than 2% of the fish were missing tags the whole tag group was to be re-tagged. After checking for tag retention the fish were released in the general location of capture. On Thursdays after the tagged fish had recovered from anesthesia they were immediately released into the river. Prior to release 100 fish were randomly selected and checked for tag retention. Unique tag codes were used for fish held for 24 hrs. prior to release and for fish immediately released both above and below the falls.

Sorting and tagging took place during the morning hours to take advantage of the cooler water temperatures. After tagging was completed the crew began seining to capture the following day's tag group.

Results:

A total of 11,460 juvenile fall chinook salmon were successfully tagged and released in the Deschutes River between 5 June - 11 July, 2002. Of these 7,278 were released below Sherar's falls and 4,182 were released above the falls (Table 7). These numbers have been adjusted for estimated tag retention (Table 8).

Table 7. Juvenile fall chinook salmon CWTed in the Deschutes River by release strategy and location during 2002.

Tag Code	# Released	Release Location	Type of Release
16-72-00	3802	Below SHF	24 hr. holding
16-72-01	3476	Above SHF	Immediate Release
16-72-02	1265	Below SHF	24 hr. holding
16-72-03	2917	Above SHF	Immediate Release

Handling mortality for fish held for 24 hrs. after tagging averaged less than 1% (0.96%). Tag retention for fish held for 24 hrs. averaged 99.5%. Tag retention in recaptured fish was 100% (Table 7). This data is for "large" and "small" fish combined. However there appeared to be no significant difference in handling mortality and tag retention rates among the two sizes of fish tagged i.e. 55-69 mm and >70 mm.

Table 8. Handling mortality and tag retention of juvenile fall chinook salmon CWTed in the Deschutes River during 2002.

Location	% Mortality	% Tag Retention (# Checked)	% Recapture Tag Retention (# Checked)
Below SHF	1.06	99.7 (611)	100 (50)
Above SHF	.85	99 (307)	100 (12)
Mean	.96	99.45 (911)	100 (62)

Discussion:

Despite the late start in tagging the 2002 juvenile fall chinook salmon brood year the results indicate that a CWT program in the Deschutes River is feasible. The use of in-river net pens allowed for the evaluation of 24 hr. tag retention. The recapture of previously tagged fish provided a good indication of delayed tag loss. The assistance of ADF&G Fisheries Biologist Dave Magnus from June10 through 14 was invaluable for determining head mold size selection and other tagging nuances that enabled efficient field tagging.

In order to implement a successful juvenile fall chinook salmon CWT program in the Deschutes River tagging should begin near 15 April. This is when the mean fork length of the fish reached the minimum tagging size of 45 mm. Due to the brief period that juvenile fall chinook salmon rear in the Deschutes River tagging should begin below Sherar's falls and progress upstream. Tagging below Sherar's falls should be completed by mid- May and by late June above Sherar's falls before peak out migration occurs.

Table 9. Estimated number of juvenile fall chinook salmon that may be tagged during 2003.*

Sampling Week	Sampling Location	Av. Fish/hr. Captured	Hours Sampled/ Day	Fish CWT'ed /Wk.	% Handling Mortality	% Tag Retention	Adjusted Fish CWT'ed /Wk.
April 14-17	Below SHF	300	5	6000	1.06	99.7	5919
April 21-24	Below SHF	300	5	6000	1.06	99.7	5919
April 28-May 1	Below SHF	270	5	5400	1.06	99.7	5327
May 5-8	Below SHF	270	5	5400	1.06	99.7	5327
May 12-15	Below SHF	150	5	3000	1.06	99.7	2959
May 19-22	Above SHF	200	5	4000	.85	99.0	3938
May 26-30	Above SHF	200	5	4000	.85	99.0	3938
June 2-5	Above SHF	200	5	4000	.85	99.0	3938
June 9-12	Above SHF	200	5	4000	.85	99.0	3938
June 16-20	Above SHF	150	5	3000	.85	99.0	2945
June 23-26	Above SHF	150	5	3000	.85	99.0	2945
Totals:				47,800			47,093

*- The catch rate above Sherar's falls from 9 June-26 June is estimated because sampling did not occur in this area during this time period during 2002.

Based upon the catch per hour of effort during 2002 and assuming a similar adult escapement in 2003, we expect to CWT approximately 47,093 juvenile fall chinook salmon in 2003 and future years. This estimate has been adjusted for handling mortality and tag retention based upon our 2002 observations (Table 9).

References:

Cramer, S.P. and J.T. Martin. 1978. Rogue basin evaluation program, juvenile progress report. Oregon Department of Fish and Wildlife. Fish Research Project DACW-57-75-C-0109. Annual Progress Report. Portland.

Jonasson, B.C. and R.B. Lindsay 1988. Fall chinook salmon in the Deschutes River, Oregon. Oregon Department of Fish and Wildlife Information Report 88-6, Portland.